99-0002591

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OCT 29 1999

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004

Dear Mr. Chairman:

SUBJECT: Recent Board Visit and Transmit Issue 3a

I thank you for the successful meeting held on October 19th and 20th, 1999, in which Defense Nuclear Facilities Safety Board members Drs. Eggenberger, Mansfield and members of your staff participated. The discussions held on functional classification and performance classification of structures, systems, and components were beneficial.

I also believe the briefing and pursuant discussion on the site's seismic ground motion were beneficial in reaching closure on the ground motion issues. To that end, I am enclosing the technical rationale your staff requested on the recent and last remaining seismic issue, Issue 3a. With this information and early review by your staff the seismic ground motion issues should be resolved.

As stated in the meeting, we are proceeding with the detailed design of current and future SRS facilities such as the Tritium Extraction Facility. In the very near future I will send you a letter describing the actions the Site has taken to increase seismic safety margin.

Should you or your staff have any questions, please contact myself or Brent Gutierrez, of my staff at (803) 725-3919.

Sincerely,

Greg Rudy
Manager

VC-00-0008

Enclosure:
Seismic Issue Resolution-Issue 3a

cc w/o encl:
M. Whitaker (EH-9), HQ

Issue No. 3a **Response Revision No.** 0

Date of Identified 9/16/99 **Date of Response** 10/28/99

Description of Issue:

Comparison Of The SRS And USGS Hard Rock Spectra

Explain, in terms of the seismologic/geologic considerations, why there are significant differences in the recommended NEHRP and SRS PC3 rock spectra, both in frequency content and amplitude.

Response:

WSRC performed a review of the applicability of NEHRP and the National Maps to the SRS. This review identified several inconsistencies when compared to a site-specific hazard assessment. Those inconsistencies involve application of generic site-response factors and inappropriate ground motion attenuation models. To provide technically comparable results to the work performed at the SRS, the USGS was commissioned to complete a hard-rock PSHA for the SRS (WSRC, 1999). The USGS computed seismic hazard for a hard-rock outcrop site located centrally at the SRS. Ground motion attenuation models consist of Atkinson and Boore (1995), Toro et.al., (1997), and Frankel et al. (1996) modified for hard-rock outcrop conditions. The United States Geological Survey (USGS) and the DOE agreed that a composite hazard model derived from a 1/3 weighting of 1- and 2-corner source attenuation models would be most appropriate for the southeastern U.S. and would best represent the hazard from a consensus opinion of ground motion experts (WSRC, 1999). The SRS hazard evaluation was done using the same source geometries and recurrence rates (including Charleston) as was done for the National Map (Frankel, 1999). The USGS provided hard-rock seismic hazard curves for 1, 2, 3, 5, and 10-hertz spectral accelerations, and peak ground acceleration, and these are included with WSRC (1999).

Figure 1 compares the 2-Hz seismic hazard curves from the National Map, a seismic hazard curve derived from the National Map for hard-rock (labeled 80% of National Map value which follows NEHRP97 site response factor for hard-rock), and the actual hard-rock hazard curve provided by the USGS (weighted average of 3 attenuation models as described above). Figure 1 clearly illustrates that the National Map derived hard-rock curve (80% curve) provides an overconservative estimate of seismic hazard for hard-rock site conditions at SRS. This is particularly important when hard-rock seismic hazard is used as input into quantification of site response. In other words, it is not correct to use as input seismic hazard curves derived from the National Map, adjusted for "hard-rock" based on NEHRP97.

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This issue is also illustrated by Figure 2 which displays the 2500 year return period based on NEHRP97 hard-rock (site class A) response spectrum for SRS. Also shown in Figure 2 is the USGS SRS-specific hard-rock UHS for a 2500 year return period (Frankel, 1999) for the case where only two attenuation models are used (same as National Map), and for the case where three models are used (preferred approach as discussed above). Figure 2 clearly shows that the spectral shapes and levels are inconsistent; the USGS curves are shifted to the high frequency and are lower relative to the NEHRP97 derived "hard-rock" spectrum.

Clearly, the "hard-rock" spectrum derived from NEHRP97 is biased as compared to the actual USGS hard-rock curves, a result of inappropriate ground motion attenuation functions and inappropriate site response factors. Since USGS bedrock hazard is the fundamental ingredient to the recommended NEHRP spectrum, the more recent and direct hard-rock UHS is most appropriate to compare to SRS hard-rock UHS. This comparison points to issues with the NEHRP recommendations also pointed out in WSRC (1999) for soil site category D. Based on WSRC (1999) and this hard-rock comparison, it is the position of WSRC and DOE that the site response factors from NEHRP97 are inappropriate for SRS. As an alternative for the SRS, USGS computed hard rock hazard was used to compute site-specific soil surface hazard (WSRC, 1999).

The soil surface hazard based on the USGS hard-rock input is compared to Electric Power Research Institute (EPRI) (NEI, 1994) and Lawrence Livermore National Laboratory (LLNL) (Bernreuter, 1997) soil surface hazard for the SRS. Figure 3 illustrates the PC3 level UHS (5×10^{-4}/yr) for the three in comparison to the current SRS Rev. 4 of 1060 PC3 design basis. With the exception of 1-Hz, the USGS and LLNL spectral levels are within about 15% or less of each other. To illustrate the sensitivity of the SRS design basis to the USGS hard-rock hazard, the USGS hazard results can be considered as one of the expert groups. Figure 3 also illustrates the combined USGS, EPRI and LLNL soil surface UHS (5×10^{-4}/yr) as compared to the SRS PC3 design spectrum. If the USGS hazard is combined as an expert group, the combined hazard is consistent with Rev. 4 of 1060. Thus the PC3 soil Design Basis Earthquake spectrum is sufficiently conservative to address the USGS hard-rock hazard for SRS.

Given the range of uncertainty which currently exists with respect to seismic sources and ground motion attenuation, it is not appropriate to base seismic hazard on the USGS input alone. The sensitivity comparison shown by Figure 3 provides confidence that the SRS PC3 soil spectrum includes sufficient conservatism to address the USGS National Seismic Hazard Map information.

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Savy, J.B., 1996. Fission Energy and Systems Safety Program, April 24, 1996, SANT96-147JBS, letter from J.B. Savy, Deputy Associate Program Leader Natural Phenomena Hazards to Jeff Kimball, DOE.

Toro, G., N. Abrahamson, and J. Schneider, 1997. Model of strong ground motion in eastern and central North America: best estimates and uncertainties, Seism. Res. Lett. Vol. 68, 41-57.

WSRC, 1999. Computation of USGS Soil UHS and Comparison to NEHRP and PC1 Seismic Response Spectra for the SRS, PECD-SGS-99-0151.

Figure Captions:

1. Comparison of National Map and revised hard-rock hazard curves for 2-Hz spectral frequency.
2. Comparison of 2500 year NEHRP and USGS hard-rock UHS.
3. Comparison of LLNL, EPRI and USGS UHS at 5 x 10-4/yr with SRS Std. 1060 Rev. 4 PC3 design basis. Also shown is the combined LLNL, EPRI and USGS UHS with 1/3 weighting.

Figure 1
USGS 2 Hertz HAZARD CURVE AT SRS

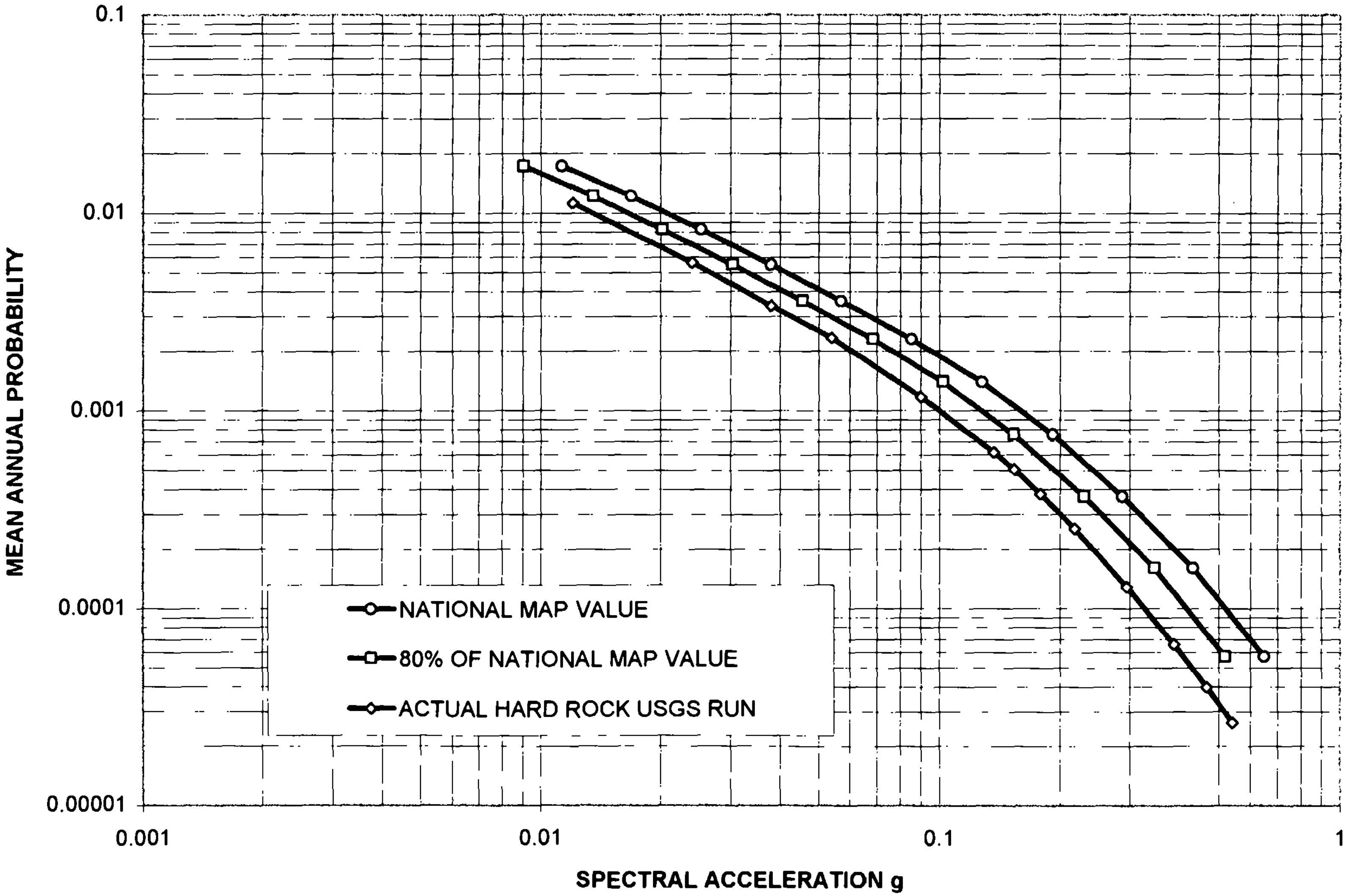
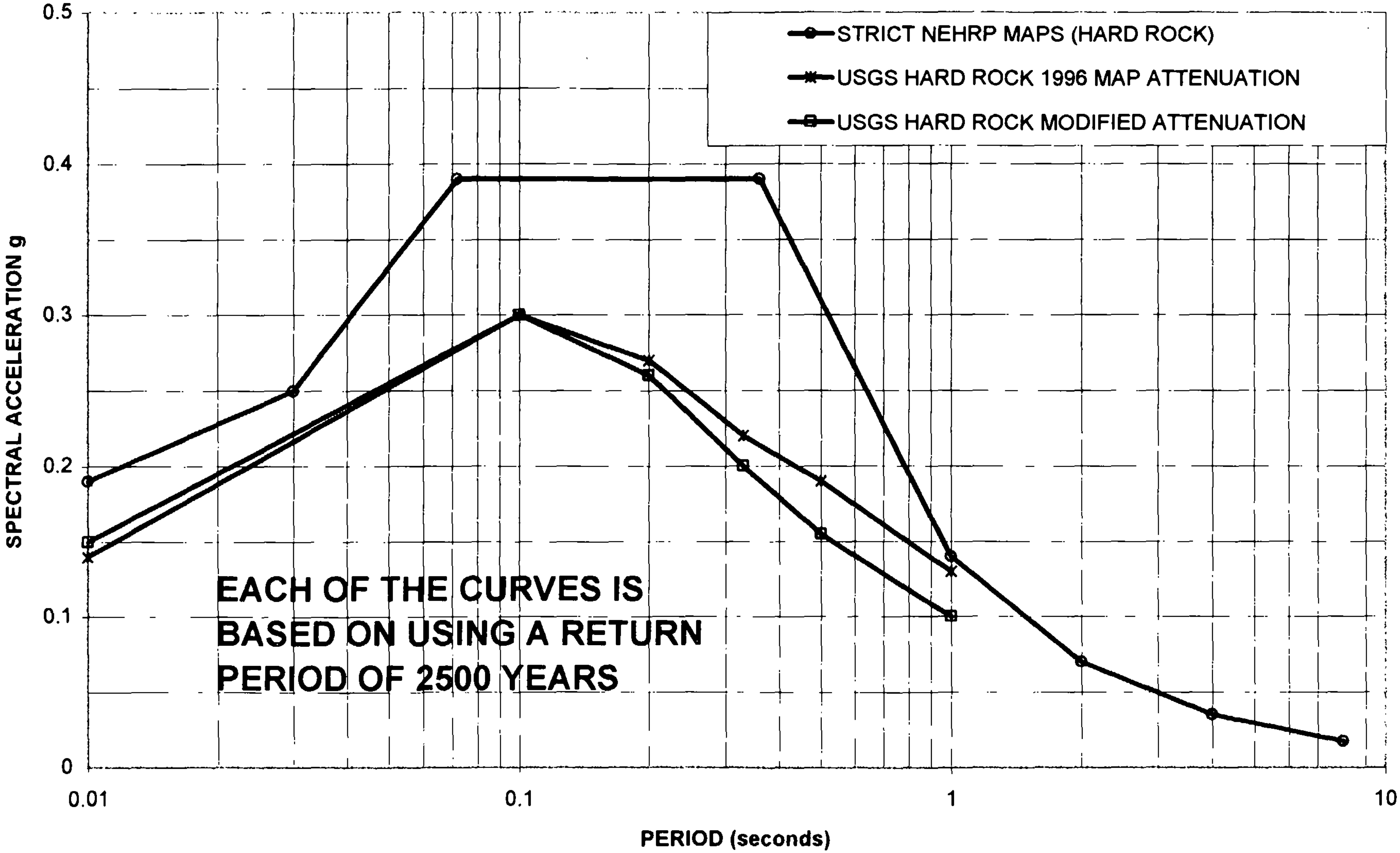
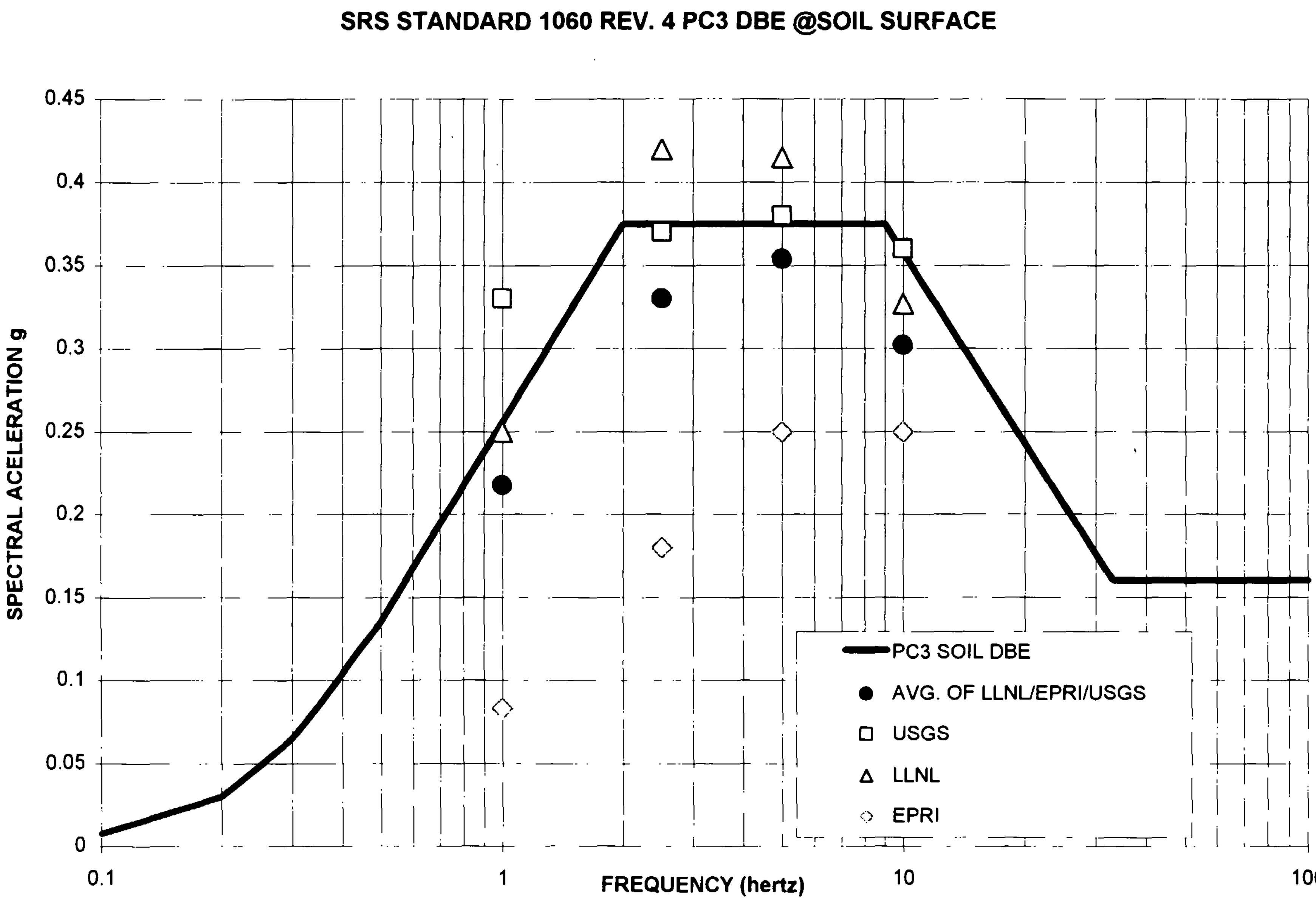


Figure 2
SEUS HARD ROCK SPECTRA COMPARISONS




SRS STANDARD 1060 REV. 4 PC3 DBE @SOIL SURFACE
SPECTRAL ACELERATION g
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.1
1
10
100
FREQUENCY (hertz)
PC3 SOIL DBE
AVG. OF LLNL/EPRI/USGS
USGS
LLNL
EPRI